Adapting Masonry Veneers to Comply With NECB 2017

By Mark Hagel, PhD, PEng

Figure 1. Calgary office building – elevation.

Masonry is a 5,000-year-old building technology that has been proven to perform in all types of built environments because of its inherent resistance to fire, insects, and moisture degradation. However, the design requirements for buildings have expanded from simply providing shelter to include maximizing the use of space, energy, sound, and light. As a result, masonry must adapt to meet modern construction requirements that include exceptional thermal performance, effective moisture management, and more-efficient use of space.[1] The latest version of Canada's *National Energy Code for Buildings* (NECB) 2017[2] requires more extensive modeling to account for thermal bridging than the preceding versions, NECB 2011[3] and NECB 2015.[4]

This article will explore techniques to meet the increased thermal performance for full-bed masonry veneers as well as adhered thin masonry veneers such as adhered thin brick and adhered thin natural and manufactured stone veneers. The article also discusses the use of the "simple prescriptive trade-off" compliance path in NECB 2017 and its application to some traditional masonry elements such as school gym walls and walls for light industrial low-rise buildings. These types of structures typically have low fenestration and door-to-wall ratios (FDWRs) and simple rectangular geometry. Using the prescriptive trade-off compliance path in NECB 2017 for the opaque wall and the glazing in these low FDWR buildings can help reduce the insulation demand resulting in more cost-effective designs.

This article includes R-values and U-factors in both imperial (inch-pound) and metric (SI) units. Within the text, R-values in SI units use the abbreviation "RSI."

NECB 2017 PRESCRIPTIVE PATH–SIMPLE TRADE-OFF METHOD

As with previous versions (NECB 2011 and NECB 2015), the NECB 2017 permits trade-off between opaque wall components and less-energy-efficient fenestration components under the prescriptive path. However, where the NECB 2011 permitted trade-off between any component in the building envelope—such that roof insulation could be traded against wall insulation—the NECB 2017 only permits trade-offs between components in the same orientation. For example, NECB 2017 permits trade-off of fenestration and thermal demand between above-grade walls on different

$$\Sigma\,(U_{i\,,\text{actual building}} \times A_{i,\text{ actual building}}) \le \Sigma\,(U_{i,\text{ prescriptive}} \times A_{i,\text{ actual building}})$$

Equation 1

elevations (vertical orientation) but does not allow increased thermal efficiency of a roof (horizontal orientation) to reduce the insulation demand of the walls (vertical orientation).

The simple trade-off method compares the total thermal transmittance (U-factor) through an area of the component of the proposed building to the thermal transmittance through that same element in the proposed building designed according to the prescriptive requirements provided by the NECB 2017. By using a smaller FDWR than the prescriptive FDWR for a particular geographic location, the insulation demand of the opaque wall can be reduced below the insulation demand of the prescriptive requirement because fenestration has much larger thermal transmittance targets (that is, 1.9 W/m^2 K) than opaque walls (that is, 0.210 W/m^2 K). The simple trade-off method is best illustrated with an example. In this example, an office building located in Calgary, Alberta, is selected that has an elevation as presented in *Figure 1*.

The number of heating-degree days (HDD) for this location is 5,000, which, according to NECB 2017, yields an FDWR of 0.333 (33.3%). For this location, the prescriptive requirement for the opaque walls is an SI U-factor of 0.210 (RSI-4.7 [R-27]), while the fenestration must have an SI U-factor of 1.9 (RSI-0.53 [R-3.0]). The translation of these requirements is that for any building under consideration located in Calgary that has 33.3% of the wall area comprised of glazing and doors with an R-value of R-3.0, the required opaque wall R-value is R-27. The dimensions for the total wall of the elevation in *Figure 1* equate to a wall area of 43.9 m (144 ft) long by 13.4 m (44 ft) tall, which equals a total wall area of 588.63 m^2 (6336 ft^2). The window bands are 7.09 m (23.3 ft) wide by 1.6 m (5.3 ft) tall in elevation. On the main floor of this elevation, there are 2.6-m- (8.8-ft-)tall doors and windows. This translates into an FWDR of 0.243 (24.3%). The smaller FWDR will result in a larger permissible U-factor for the opaque walls (and smaller R-value for the opaque walls).

When the wall areas, prescriptive U-factors, and actual U-factors for this building are input into the energy balance calculation, the result is a prescriptive maximum energy consumption of the walls in watts/kelvin (W/K). This value cannot be exceeded based on the simple multiplication of the U-factor by the wall or fenestration area, respectively. Mathematically this can be expressed as seen in *Equation 1*.

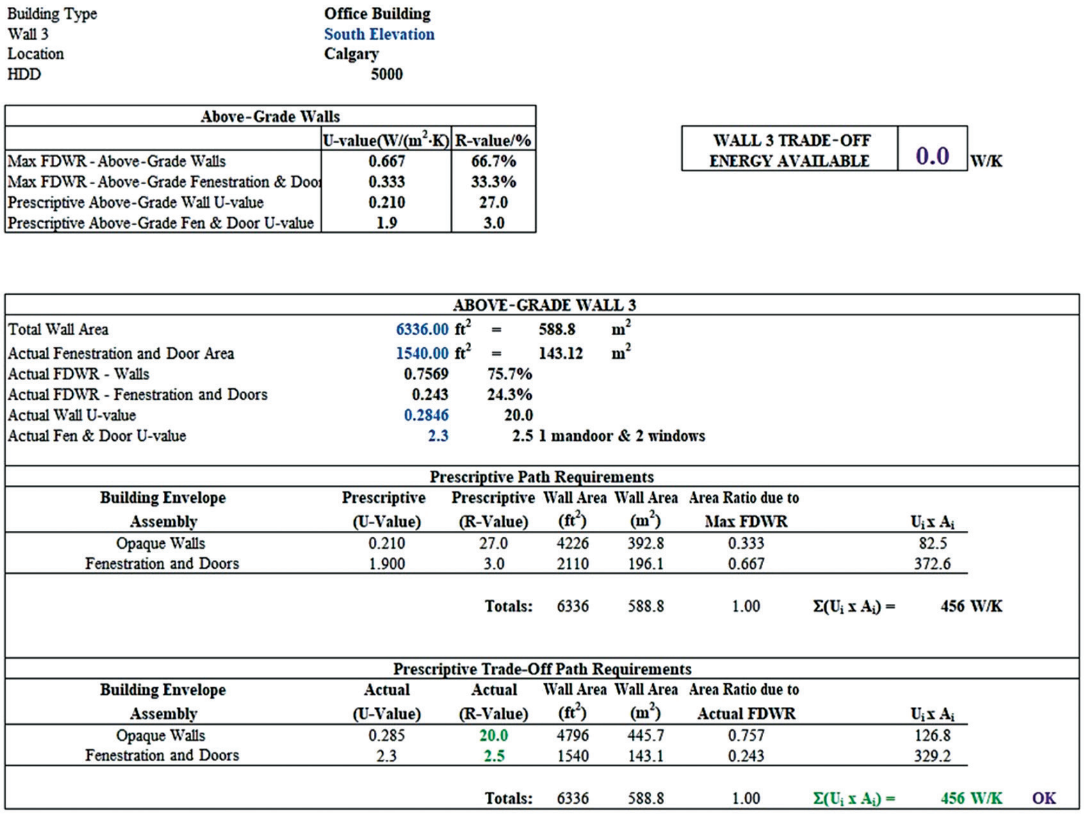
In *Equation 1*, U_i is the U-factor of the component (in units of W/m^2 K), and A_i is the area of the component (in units of m^2). In *Figure 2*, it can be seen that utilizing improved thermally broken double-glazed windows and doors of R-2.5 translates to a required R-value for the opaque walls of R-20. In *Figure 2*, the prescriptive trade-off path with R-20 walls and R-2.5 windows and doors equates to a heat transfer through the total wall area of 456 W/K, which is less than or equal to (in this case equal

to) the permitted prescriptive requirement of 456 W/K.

Alternatively, the wall R-value could be increased and traded to another elevation with a larger FWDR to provide a consistent insulation demand for all walls of all elevations. In *Figure 3*, it can be seen that using the same R-2.5 windows and doors but increasing the R-value of the walls to R-24 results in a total heat transmittance of 434 W/K. In this case, 434 W/K is 22.0 W/K less than the permitted 456 W/K. This 22.0 W/K can simply be added to the "prescriptive path requirements total" of a wall on another elevation or subtracted from the "prescriptive trade-off path requirements total." The increase in 22.0 W/K could permit a larger FDWR (more glazing) on an identical elevation (FWDR = 27.9% instead of 24.3%).

FULL-BED MASONRY-VENEER EXAMPLES

Now that the simple trade-off method has been explained, techniques to comply with NECB 2017 requirements using full-bed masonry veneers can be discussed. One of the most common forms of full-bed masonry veneers is their use in the construction of wood-framed, multifamily residential buildings. *Figure 4* provides an example of this type of construction as illustrated in 3-D isometric from the *Building Envelope Thermal Bridging Guide*.[5] Typically, the walls are constructed of 2 × 6 spruce-pine-fir (SPF) dimension-cut lumber, insulated between the studs with glass-fiber-batt insulation. The vapor barrier is typically a 6-mil polyethylene sheet installed between the studs and the interior sheathing (typically 13 mm [½ in.] drywall), and a weather-resistant membrane (typically two layers of 30-minute building paper) is installed over the exterior grade



Building Type	Office Building
Wall 3	South Elevation
Location	Calgary
HDD	5000

Above-Grade Walls	U-value(W/(m^2·K)	R-value/%
Max FDWR - Above-Grade Walls	0.667	66.7%
Max FDWR - Above-Grade Fenestration & Doo	0.333	33.3%
Prescriptive Above-Grade Wall U-value	0.210	27.0
Prescriptive Above-Grade Fen & Door U-value	1.9	3.0

WALL 3 TRADE-OFF ENERGY AVAILABLE	0.0	W/K

ABOVE-GRADE WALL 3

Total Wall Area	6336.00 ft^2	=	588.8	m^2
Actual Fenestration and Door Area	1540.00 ft^2	=	143.12	m^2
Actual FDWR - Walls	0.7569	75.7%		
Actual FDWR - Fenestration and Doors	0.243	24.3%		
Actual Wall U-value	0.2846	20.0		
Actual Fen & Door U-value	2.3	2.5 1 mandoor & 2 windows		

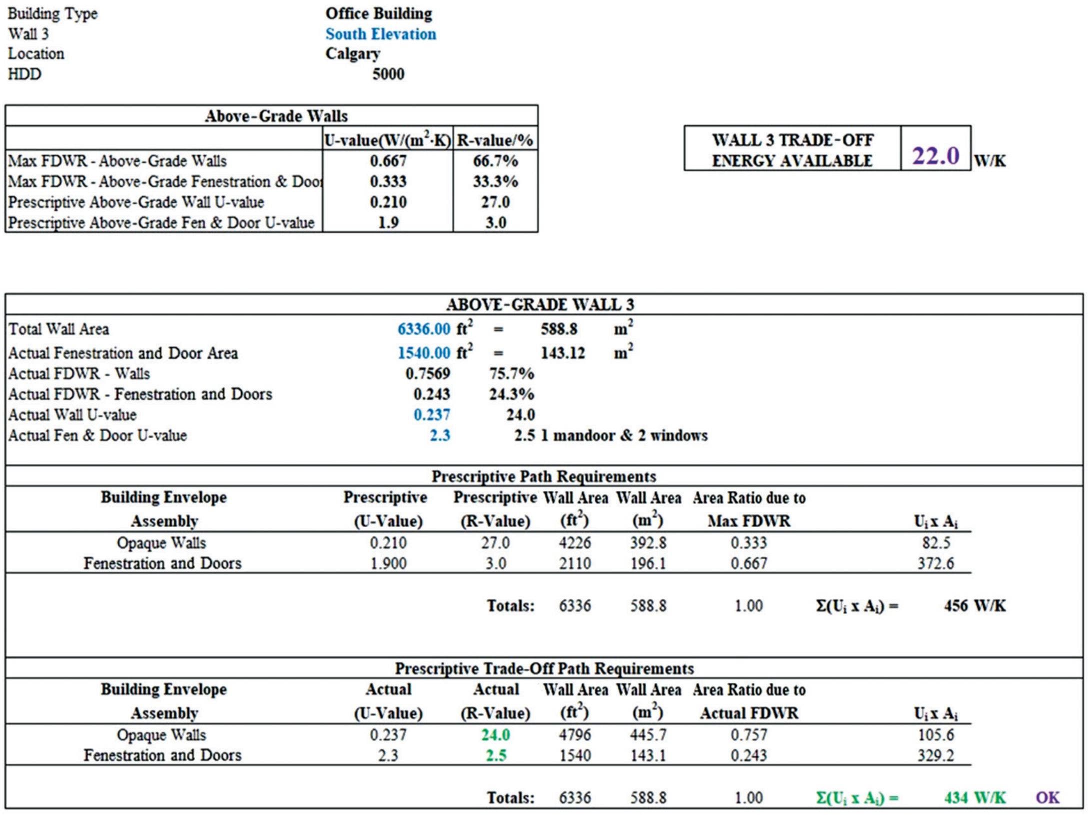
Prescriptive Path Requirements

Building Envelope Assembly	Prescriptive (U-Value)	Prescriptive (R-Value)	Wall Area (ft^2)	Wall Area (m^2)	Area Ratio due to Max FDWR		U_i x A_i
Opaque Walls	0.210	27.0	4226	392.8	0.333		82.5
Fenestration and Doors	1.900	3.0	2110	196.1	0.667		372.6
		Totals:	6336	588.8	1.00	Σ(U_i x A_i) =	456 W/K

Prescriptive Trade-Off Path Requirements

Building Envelope Assembly	Actual (U-Value)	Actual (R-Value)	Wall Area (ft^2)	Wall Area (m^2)	Area Ratio due to Actual FDWR		U_i x A_i	
Opaque Walls	0.285	20.0	4796	445.7	0.757		126.8	
Fenestration and Doors	2.3	2.5	1540	143.1	0.243		329.2	
		Totals:	6336	588.8	1.00	Σ(U_i x A_i) =	456 W/K	OK

Figure 2. Energy balance for Canada's National Energy Code for Buildings 2017 simple trade-off compliance between walls and glazing on a commercial steel-stud brick-veneer building.



Building Type	Office Building
Wall 3	South Elevation
Location	Calgary
HDD	5000

Above-Grade Walls	U-value(W/(m^2·K)	R-value/%
Max FDWR - Above-Grade Walls	0.667	66.7%
Max FDWR - Above-Grade Fenestration & Doo	0.333	33.3%
Prescriptive Above-Grade Wall U-value	0.210	27.0
Prescriptive Above-Grade Fen & Door U-value	1.9	3.0

WALL 3 TRADE-OFF ENERGY AVAILABLE	22.0	W/K

ABOVE-GRADE WALL 3

Total Wall Area	6336.00 ft^2	=	588.8	m^2
Actual Fenestration and Door Area	1540.00 ft^2	=	143.12	m^2
Actual FDWR - Walls	0.7569	75.7%		
Actual FDWR - Fenestration and Doors	0.243	24.3%		
Actual Wall U-value	0.237	24.0		
Actual Fen & Door U-value	2.3	2.5 1 mandoor & 2 windows		

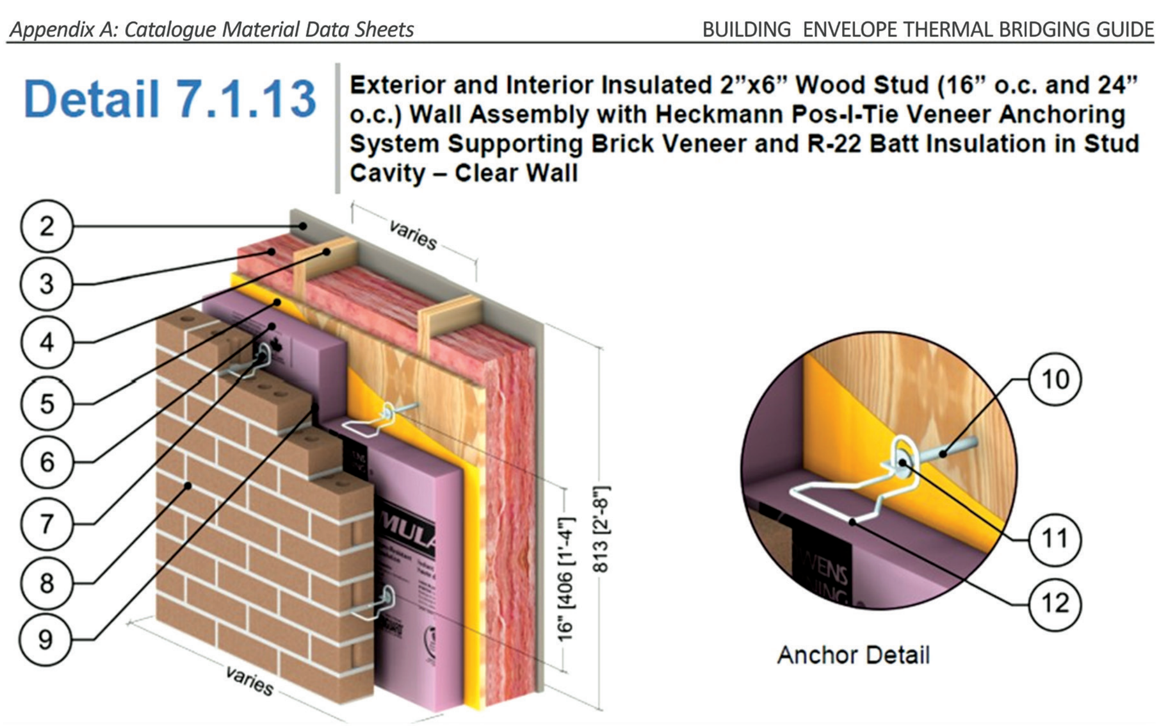
Prescriptive Path Requirements

Building Envelope Assembly	Prescriptive (U-Value)	Prescriptive (R-Value)	Wall Area (ft^2)	Wall Area (m^2)	Area Ratio due to Max FDWR		U_i x A_i
Opaque Walls	0.210	27.0	4226	392.8	0.333		82.5
Fenestration and Doors	1.900	3.0	2110	196.1	0.667		372.6
		Totals:	6336	588.8	1.00	Σ(U_i x A_i) =	456 W/K

Prescriptive Trade-Off Path Requirements

Building Envelope Assembly	Actual (U-Value)	Actual (R-Value)	Wall Area (ft^2)	Wall Area (m^2)	Area Ratio due to Actual FDWR		U_i x A_i	
Opaque Walls	0.237	24.0	4796	445.7	0.757		105.6	
Fenestration and Doors	2.3	2.5	1540	143.1	0.243		329.2	
		Totals:	6336	588.8	1.00	Σ(U_i x A_i) =	434 W/K	OK

Figure 3. Energy balance for Canada's National Energy Code for Buildings 2017 simple trade-off compliance between walls and glazing on a commercial steel-stud brick-veneer building.



Appendix A: Catalogue Material Data Sheets BUILDING ENVELOPE THERMAL BRIDGING GUIDE

Detail 7.1.13 **Exterior and Interior Insulated 2”x6” Wood Stud (16” o.c. and 24” o.c.) Wall Assembly with Heckmann Pos-I-Tie Veneer Anchoring System Supporting Brick Veneer and R-22 Batt Insulation in Stud Cavity – Clear Wall**

Figure 4. Wood-framed brick-veneer wall assembly.[5]

sheathing (typically 10 mm [⅜ in.] OSB). Cavity insulation, a 25-mm (1-in.) air gap, and the 3⅝-in.-thick brick veneer tied to the structural wall with metal brick ties completes the system (*Figure 4*).

In *Figure 5*, to account for thermal bridging, the new requirements of NECB 2017 have been used. The familiar equation is used to aggregate the components into a composite U-factor given by *Equation 2*.

This equation has been conveniently integrated into a spreadsheet (*Figure 6*)[6] that is complemented by a catalogue of thermal details from a prominent Canadian building engineering firm.[5] In the example in *Figure 5*, the building elevation has the various thermal bridging elements identified by color. The green outline identifies the clear field wall area for the U_o calculation; the purple lines identify the linear thermal bridges formed by the fenestration, at grade,

Figure 5. Wood-framed multi-family residential building example.

$$U_T = \frac{\Sigma(\Psi \cdot L) + \Sigma(\chi)}{A_{Total}} + U_o$$

Equation 2

where

U_T = the total effective thermal transmittance (W/m^2 K)

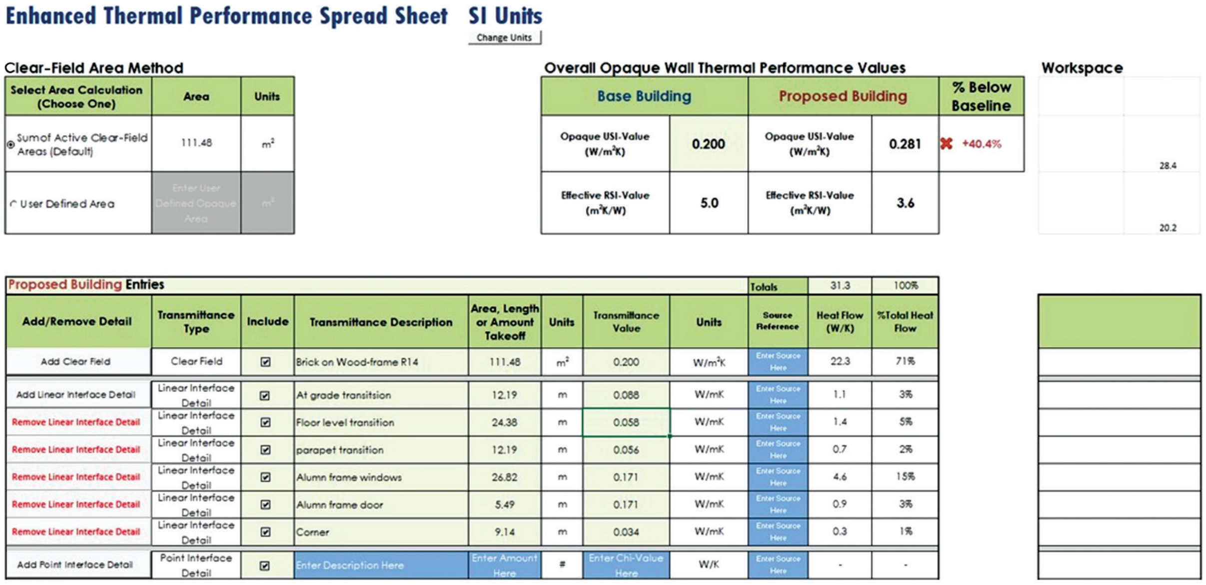
U_o = the clear field thermal transmittance (W/m^2 K)

A_{Total} = the total opaque wall area (m^2)

Ψ = the heat flow from a linear thermal bridge (W/m K)

L = the length of the linear thermal bridge (m)

χ = the heat flow from a point thermal bridge (W/K)



Enhanced Thermal Performance Spread Sheet **SI Units**

Change Units

Clear-Field Area Method

Select Area Calculation (Choose One)	Area	Units
● Sumof Active Clear-Field Areas (Default)	111.48	m²
○ User Defined Area	Enter User Defined Opaque Area	m²

Overall Opaque Wall Thermal Performance Values

Base Building		Proposed Building		% Below Baseline
Opaque USI-Value (W/m²K)	0.200	Opaque USI-Value (W/m²K)	0.281	✖ +40.4%
Effective RSI-Value (m²K/W)	5.0	Effective RSI-Value (m²K/W)	3.6	

Workspace

28.4

20.2

Proposed Building Entries

Totals 31.3 100%

Add/Remove Detail	Transmittance Type	Include	Transmittance Description	Area, Length or Amount Takeoff	Units	Transmittance Value	Units	Source Reference	Heat Flow (W/K)	%Total Heat Flow
Add Clear Field	Clear Field	☑	Brick on Wood-frame R14	111.48	m²	0.200	W/m²K	Enter Source Here	22.3	71%
Add Linear Interface Detail	Linear Interface Detail	☑	At grade transitsion	12.19	m	0.088	W/mK	Enter Source Here	1.1	3%
Remove Linear Interface Detail	Linear Interface Detail	☑	Floor level transition	24.38	m	0.058	W/mK	Enter Source Here	1.4	5%
Remove Linear Interface Detail	Linear Interface Detail	☑	parapet transition	12.19	m	0.056	W/mK	Enter Source Here	0.7	2%
Remove Linear Interface Detail	Linear Interface Detail	☑	Alumn frame windows	26.82	m	0.171	W/mK	Enter Source Here	4.6	15%
Remove Linear Interface Detail	Linear Interface Detail	☑	Alumn frame door	5.49	m	0.171	W/mK	Enter Source Here	0.9	3%
Remove Linear Interface Detail	Linear Interface Detail	☑	Corner	9.14	m	0.034	W/mK	Enter Source Here	0.3	1%
Add Point Interface Detail	Point Interface Detail	☑	Enter Description Here	Enter Amount Here	#	Enter Chi-Value Here	W/K	Enter Source Here	-	-

Figure 6. Wood-framed multi-family residential building example – effective R-value accounting for thermal-bridging effects.[6]

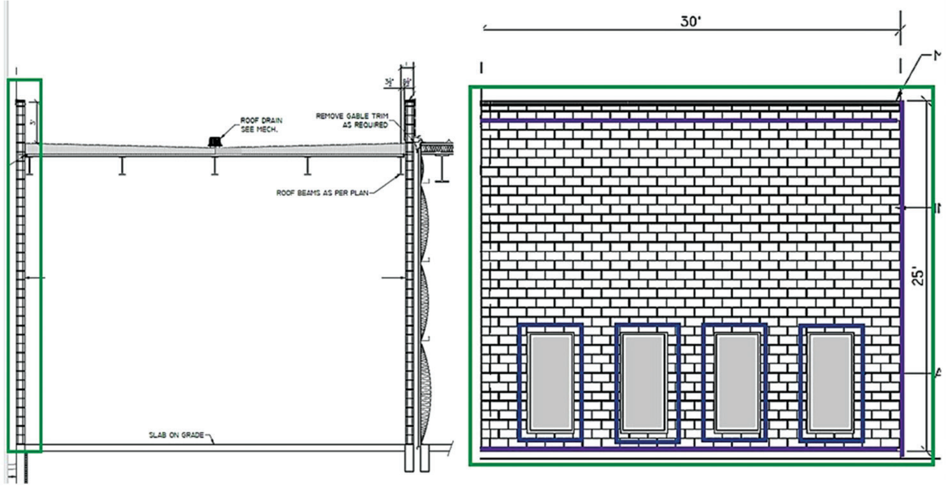
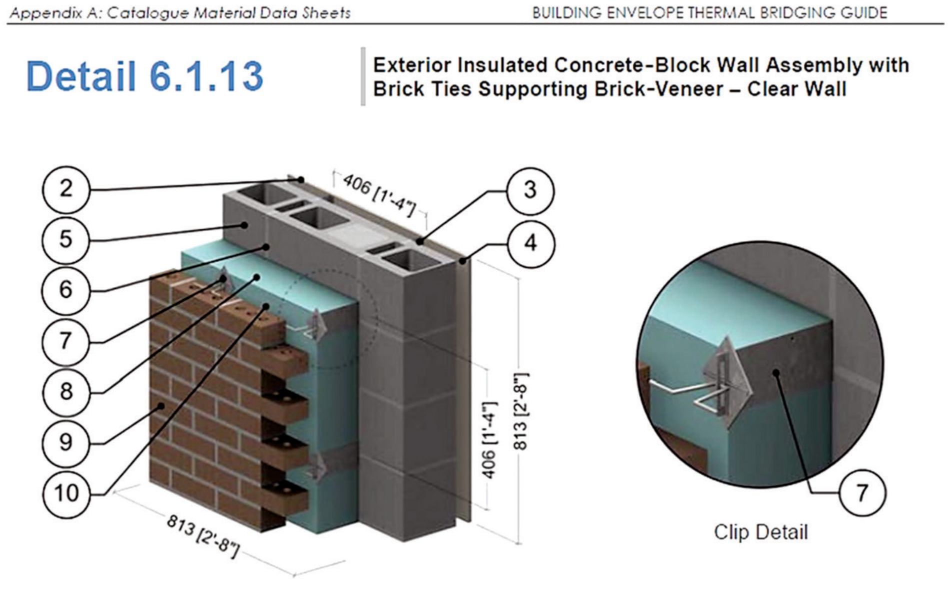


Figure 7. Concrete-block brick-veneer wall assembly.



Appendix A: Catalogue Material Data Sheets BUILDING ENVELOPE THERMAL BRIDGING GUIDE

Detail 6.1.13

Exterior Insulated Concrete-Block Wall Assembly with Brick Ties Supporting Brick-Veneer – Clear Wall

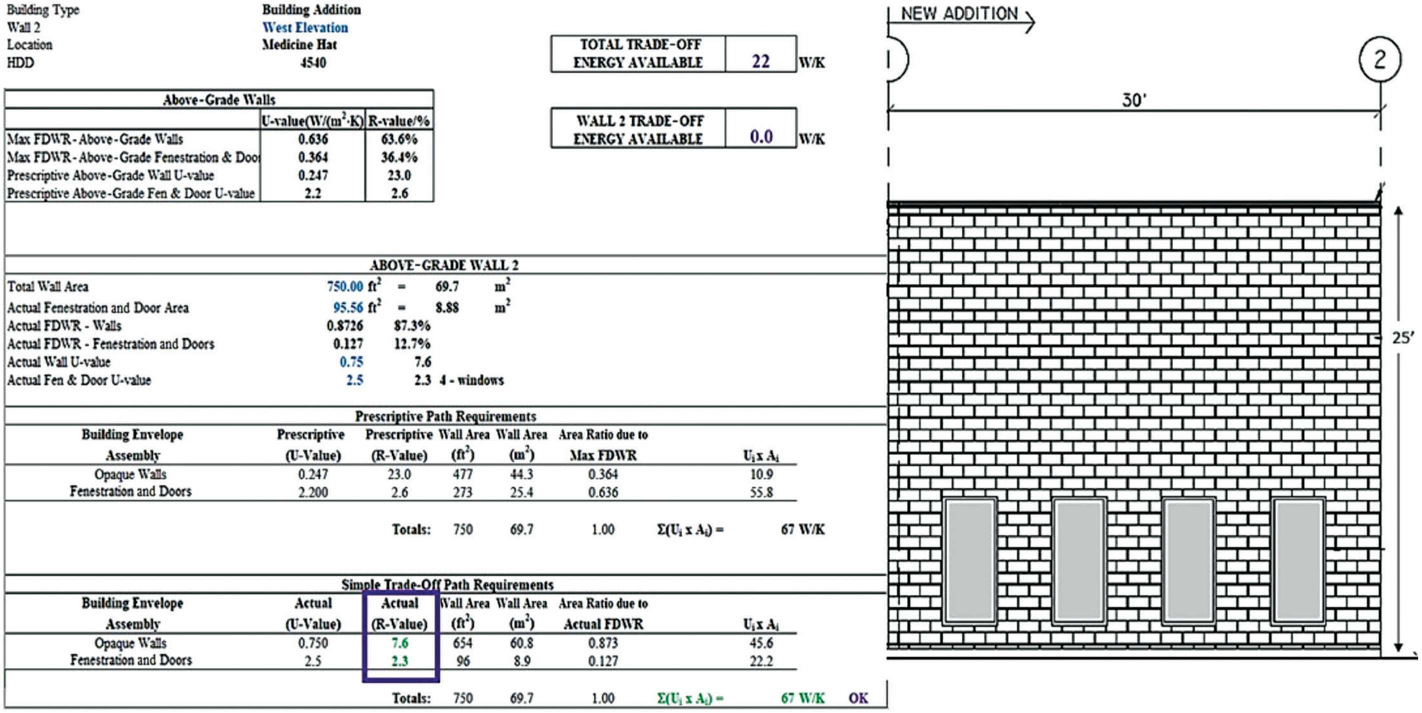
Figure 8. Concrete-block brick-veneer wall assembly.[5]

floor level, wall corner, and parapet transitions; while the blue rectangles identify the linear thermal bridges from the fenestration. *Figure 6* aggregates these components, which have a clear field R-value of R-28.4 and that reduces to an effective R-20.2 when thermal bridging effects have been included. In this particular case, the use of the simple trade-off system would be required for the wall system to comply with NECB 2017 in locations of Canada that have an HDD exceeding 4,000.

Continuing with another example where masonry is typically used is in warehouse and light industrial building applications. One elevation of an addition to an existing building using a concrete-block structural wall and brick veneer is provided in *Figure 7*. *Figure 8* provides an example of this type of concrete-block structural wall and brick-veneer construction as illustrated in a 3-D isometric view from the *Building Envelope Thermal Bridging Guide*.[5]

Assuming a location for this building in a milder climate of 4,500 HDD, a target of R-23.0 is required. The simple trade-off path between fenestration and opaque wall areas can again be applied to reduce the insulation demand in the wall assembly because there is little fenestration on the elevation in *Figure 7*. For this particular elevation of the building, trading-off actual fenestration of 12.7% to the prescriptive allowance of 36.4% results in a wall insulation value (after accounting for thermal bridging) of R-7.6 (RSI = 1.33) when R-2.3 (RSI = 0.4) fenestration is used (*Figure 9*).

In *Figure 7*, the building elevation is once again broken into its various thermal bridging elements, which are identified by color. Again, the green outline identifies the clear field wall area for the U_o calculation; the purple lines identify the linear thermal bridges formed by the at-grade, wall-corner, and parapet transitions; and the blue rectangles identify the linear thermal bridges from the windows. *Figure 10*



Building Type	Building Addition
Wall 2	West Elevation
Location	Medicine Hat
HDD	4540

TOTAL TRADE-OFF ENERGY AVAILABLE	22	W/K
WALL 2 TRADE-OFF ENERGY AVAILABLE	0.0	W/K

Above-Grade Walls	U-value(W/(m²·K)	R-value/%
Max FDWR - Above-Grade Walls	0.636	63.6%
Max FDWR - Above-Grade Fenestration & Door	0.364	36.4%
Prescriptive Above-Grade Wall U-value	0.247	23.0
Prescriptive Above-Grade Fen & Door U-value	2.2	2.6

ABOVE-GRADE WALL 2

Total Wall Area	750.00	ft²	=	69.7	m²	
Actual Fenestration and Door Area	95.56	ft²	=	8.88	m²	
Actual FDWR - Walls	0.8726			87.3%		
Actual FDWR - Fenestration and Doors	0.127			12.7%		
Actual Wall U-value	0.75			7.6		
Actual Fen & Door U-value	2.5			2.3		4 - windows

Prescriptive Path Requirements

Building Envelope Assembly	Prescriptive (U-Value)	Prescriptive (R-Value)	Wall Area (ft²)	Wall Area (m²)	Area Ratio due to Max FDWR		U_i x A_i
Opaque Walls	0.247	23.0	477	44.3	0.364		10.9
Fenestration and Doors	2.200	2.6	273	25.4	0.636		55.8
		Totals:	750	69.7	1.00	Σ(U_i x A_i) =	67 W/K

Simple Trade-Off Path Requirements

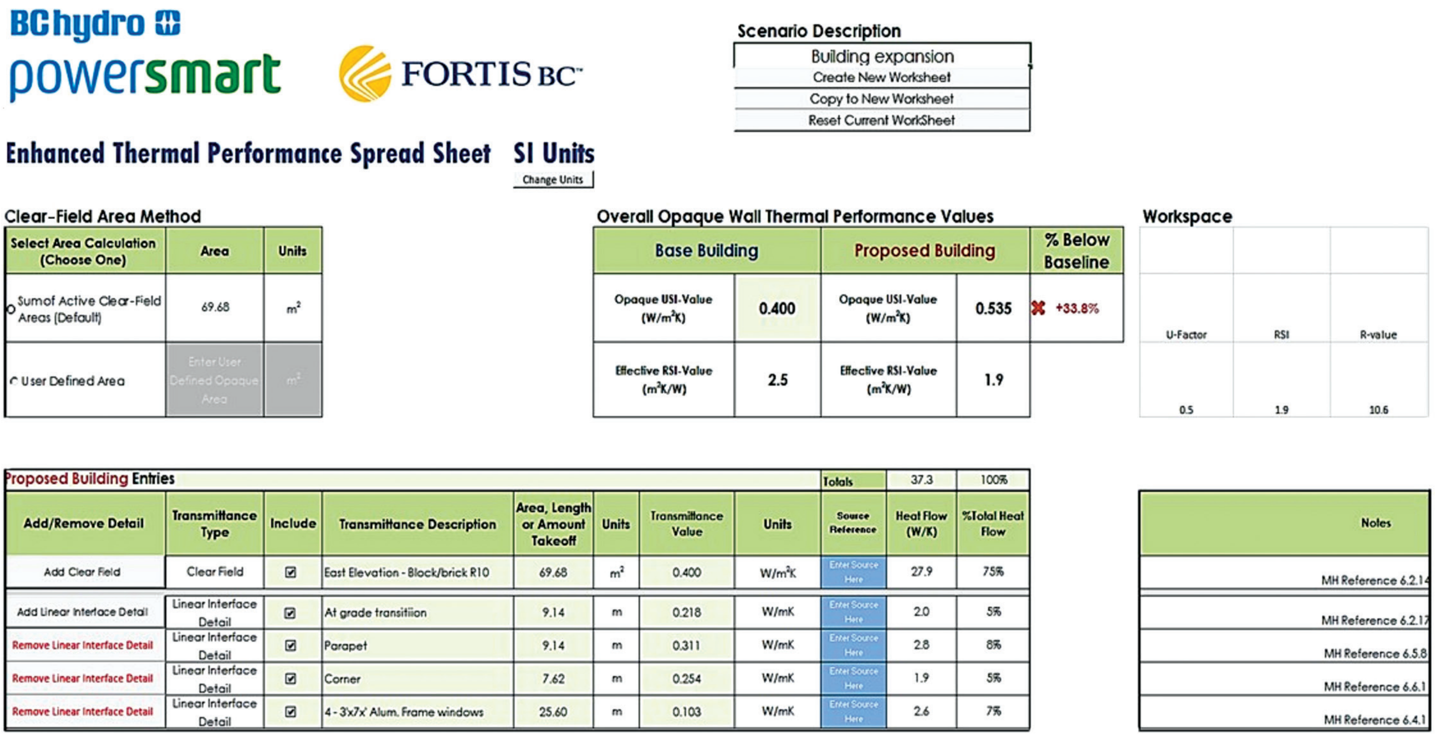
Building Envelope Assembly	Actual (U-Value)	Actual (R-Value)	Wall Area (ft²)	Wall Area (m²)	Area Ratio due to Actual FDWR		U_i x A_i	
Opaque Walls	0.750	7.6	654	60.8	0.873		45.6	
Fenestration and Doors	2.5	2.3	96	8.9	0.127		22.2	
		Totals:	750	69.7	1.00	Σ(U_i x A_i) =	67 W/K	OK

Figure 9. Simple trade-off calculation for concrete-block brick-veneer building addition.

aggregates these components, which have a clear field R-value of R-14.2, which reduces to an effective R-10.6 when thermal bridging effects have been included. The wall assembly's R-10.6 exceeds the required R-7.6 from the trade-off calculation and provides the necessary insulation with only 64 mm (2½ in.) of mineral-wool insulation.

INNOVATIONS IN MASONRY TO REDUCE THE IMPACTS OF THERMAL BRIDGING

Recent advances in the masonry industry to introduce stainless steel, glass-fiber-reinforced polymers (GFRP) and plastics, and coatings to masonry ties and shelf-angle stand-offs have reduced the thickness of exterior insulation required to achieve the same thermal performance when compared with the use of these components fabricated with traditional steel. *Figure 11* and *Figure 12* illustrate typical details for use in these technologies. For example, a thermally broken shelf angle using a coating-covered standoff as illustrated in *Figure 12* drops the ψ value from 0.322 W/m K (with typical steel) to 0.074



Scenario Description

Building expansion

Enhanced Thermal Performance Spread Sheet SI Units

Clear-Field Area Method

Select Area Calculation (Choose One)	Area	Units
○ Sumof Active Clear-Field Areas (Default)	69.68	m²
○ User Defined Area	Enter User Defined Opaque Area	m²

Overall Opaque Wall Thermal Performance Values

Base Building		Proposed Building		% Below Baseline
Opaque USI-Value (W/m²K)	0.400	Opaque USI-Value (W/m²K)	0.535	✖ +33.8%
Effective RSI-Value (m²K/W)	2.5	Effective RSI-Value (m²K/W)	1.9	

Workspace

U-Factor	RSI	R-value
0.5	1.9	10.6

Proposed Building Entries

Add/Remove Detail	Transmittance Type	Include	Transmittance Description	Area, Length or Amount Takeoff	Units	Transmittance Value	Units	Source Reference	Heat Flow (W/K)	%Total Heat Flow	Notes
								Totals	37.3	100%	
Add Clear Field	Clear Field	☑	East Elevation - Block/brick R10	69.68	m²	0.400	W/m²K	Enter Source Here	27.9	75%	MH Reference 6.2.14
Add Linear Interface Detail	Linear Interface Detail	☑	At grade transitiion	9.14	m	0.218	W/mK	Enter Source Here	2.0	5%	MH Reference 6.2.17
Remove Linear Interface Detail	Linear Interface Detail	☑	Parapet	9.14	m	0.311	W/mK	Enter Source Here	2.8	8%	MH Reference 6.5.8
Remove Linear Interface Detail	Linear Interface Detail	☑	Corner	7.62	m	0.254	W/mK	Enter Source Here	1.9	5%	MH Reference 6.6.1
Remove Linear Interface Detail	Linear Interface Detail	☑	4 - 3'x7x' Alum. Frame windows	25.60	m	0.103	W/mK	Enter Source Here	2.6	7%	MH Reference 6.4.1

Figure 10. Concrete-block brick-veneer example – effective R-value after thermal bridging effects.

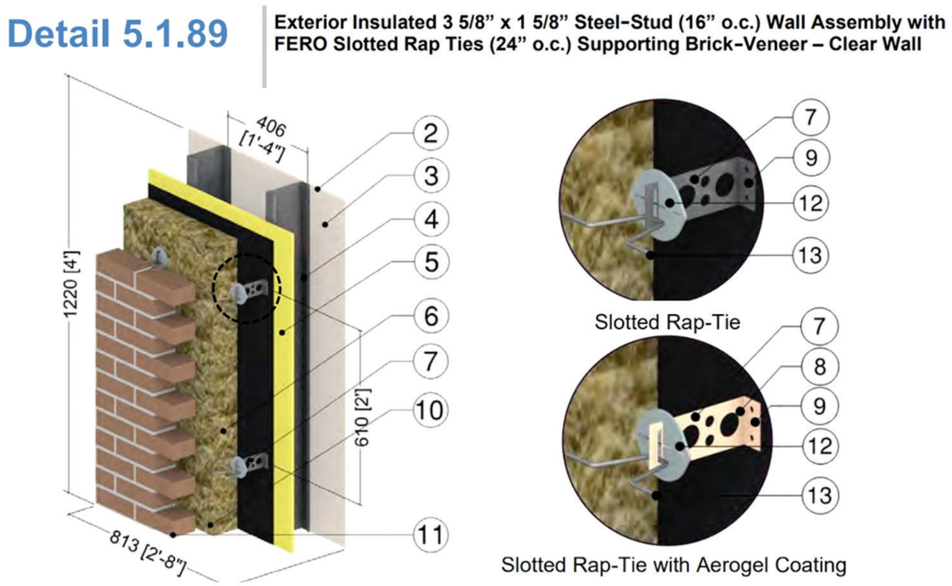


Figure 11. Steel-stud brick-veneer example – slotted rap tie with coating.[5]

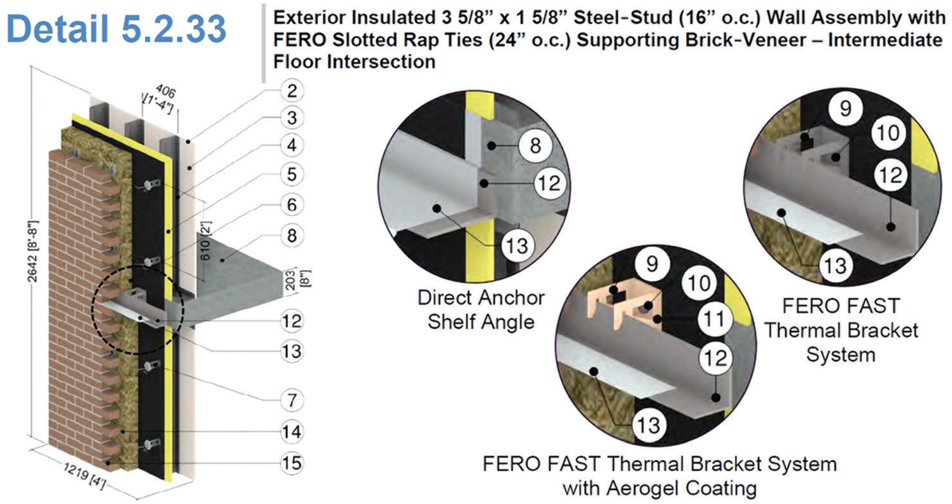


Figure 12. Steel-stud brick-veneer shelf angle example – slotted rap tie with coating.[5]

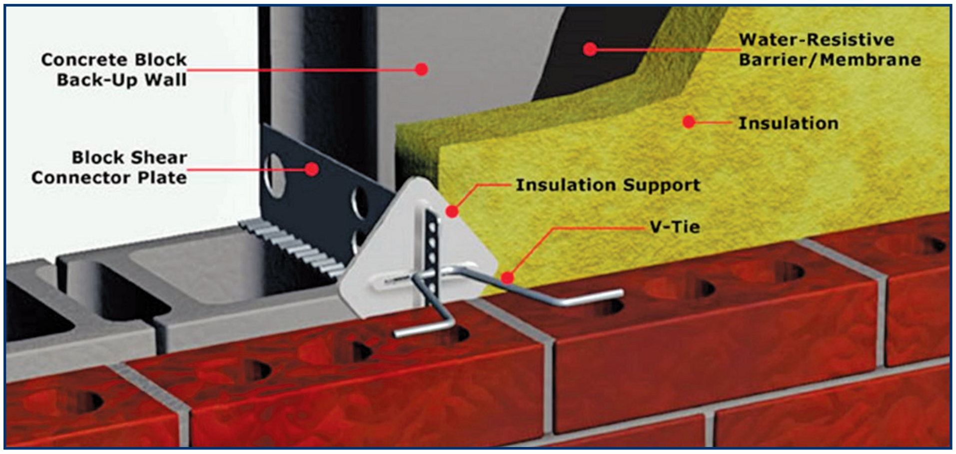


Figure 13. Slotted block tie for concrete-block brick veneer.[7]

W/m K (*Figure 12*) for an R-16.8 exterior insulation. On a gym wall with dimensions of 23.62 m (77.5 ft) by 43.56 m (143 ft) that has three exterior walls, substituting only the shelf angles results in an increase in thermal performance of RSI = 0.194 (R-1.1).

Another area where efficiencies can be found is the use of GFRP ties with concrete block backup walls. Concrete-block backup walls typically use ties that embed into the head joint of the block (*Figure 13*). When these ties are made of steel, there is significant thermal bridging. A recent 3-D thermal model demonstrated that fabricating these ties from GFRP results in an increase of approximately 10% in the clear-field wall (U_o). These thermal performance improvements to concrete-block and brick-veneer walls can translate to an improvement of up to RSI = 0.9 (R-5) in the wall performance without the addition of more insulation.

ADHERED THIN MASONRY-VENEER EXAMPLES

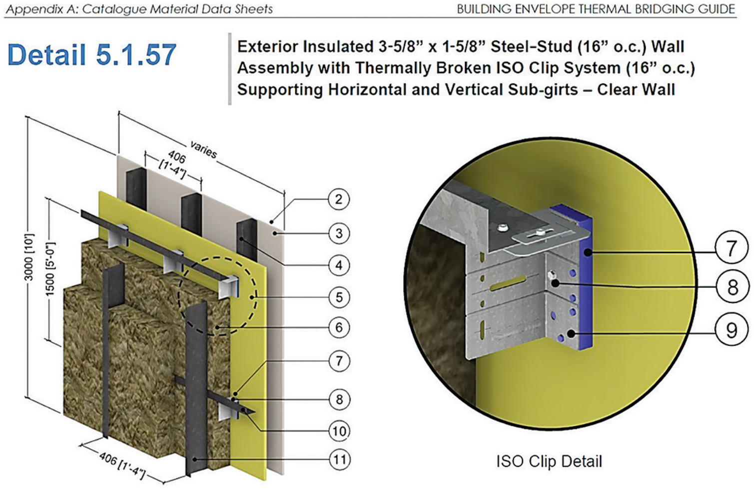
Requirements of NECB 2017 to include thermal-bridging effects of corners of walls, floor levels, at grade and parapets, and around fenestrations have led to the addition or increase in thickness of exterior insulation. In order to reduce the overall thickness of the wall, thin masonry veneers are being more frequently used with exterior-insulated steel- and wood-stud systems to reduce the overall thickness. Thin masonry veneers are typically one-third to one-fourth the thickness of full-bed masonry veneers. For example, thin brick units are typically between 13-mm and 25-mm (½-in. to 1-in.) thick, where full-bed brick units are 90-mm (3⅝-in.) thick. Thin-adhered, manufactured-stone unit thicknesses are between 13-mm and 66.7-mm (½-in. and 2⅝-in.) thick as per ASTM C1670-19,[8] *Specification for Adhered Manufactured Stone Masonry Veneer Units*, where traditional full-bed stone units are 100-mm (4-in.) thick. These thin alternatives to traditional masonry are attractive options for reducing the overall thickness of the wall if property lines and useable space constrain the wall thickness.

Using thermally broken clip systems can further improve the performance of the wall and reduce the thickness of insulation required in the wall assembly. *Figure 14* provides an illustration of a thermally broken clip system attached to a steel-stud backup wall that is supporting a black-colored adhered manufactured stone veneer. *Figure 15* provides the detail in the thermal

Figure 14. Exterior insulated steel-stud wall assembly clad with adhered manufactured thin-stone masonry veneer.

catalog that could be used in conjunction with the spreadsheet to determine the overall thermal performance of the wall. In *Figure 12* it can be seen that no cladding is specified; however, the contribution to overall value of the thin-stone veneer is less than R-0.1 (RSI = 0.018) and can be considered negligible.

Figure 15. Exterior insulated steel-stud wall assembly capable of receiving adhered thin-stone masonry veneers.


Appendix A: Catalogue Material Data Sheets BUILDING ENVELOPE THERMAL BRIDGING GUIDE

Detail 5.1.57

Exterior Insulated 3-5/8" x 1-5/8" Steel-Stud (16" o.c.) Wall Assembly with Thermally Broken ISO Clip System (16" o.c.) Supporting Horizontal and Vertical Sub-girts – Clear Wall

CONCLUSION

Several examples of the ability of masonry veneers to comply with NECB 2017 requirements were discussed. The techniques typically involve the use of the simple, prescriptive trade-off path that can offset the insulation demand increase when thermal bridging at fenestrations, floor-level, grade, parapet, and wall corner transitions are accounted for, as required by the NECB 2017.

Increased thermal performance of masonry veneers with the use of stainless steel, GFRP, plastic, and coated masonry ties and shelf-angle stand-offs were identified as emerging innovations that are being introduced to the market to further increase thermal performance of masonry veneers in the clear-field, floor, parapet, wall corner and at-grade transitions. Several of these technologies are already available.

The increase in insulation requirements has led to an increase in the thickness of the walls. Where property lines or useable interior space present a constraint in the wall thickness, adhered-masonry-veneer units provide an alternative to traditional full-bed masonry-veneer units that are typically less than half the thickness of full-bed masonry-veneer units. As a result, adhered masonry veneers can provide the masonry aesthetic with a fraction of the thickness. This option is easily thermally modelled with existing details in thermal catalogs when the contribution of the masonry veneer is ignored. Given the negligible contribution provided by the adhered masonry veneer to the overall thermal performance of the wall, this assumption is reasonable.

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IoT in the Building Enclosure

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The Internet of Things (IoT) refers to the various devices used every day around the world that are connected to the internet. This includes your smart phone, but it also may include things like your thermostat, your television, your watch, and even your coffee maker. Each of these "things" sends its data somewhere, ostensibly to become "smart" and therefore better cater to your needs. Your thermostat remembers what time to turn itself up in the morning. Your coffee starts brewing while you're in the shower. Your watch nudges you to take 45 more steps this hour. Each of these devices is intended to make your life a little easier by collecting and analyzing information.

More and more, this concept is being applied not just to "things" inside our houses, but to the actual buildings in which we live and work. You may have used sensors in your research; there are companies putting them into completed buildings to continue to monitor performance and receive advanced warning of defects. Sensors in concrete can monitor curing and drying, and report back data on strength, temperature, and relative humidity. IoT-connected sensors can also monitor for things like unusual vibrations within a building. As with any new technology, there are costs and a learning curve associated with adoption. Data safety is also a concern, and a reputable company should keep customers informed of how their data are being protected and used.

— ITProPortal, Concrete Sensors